

Epidemiology of AKI: Time for change

By

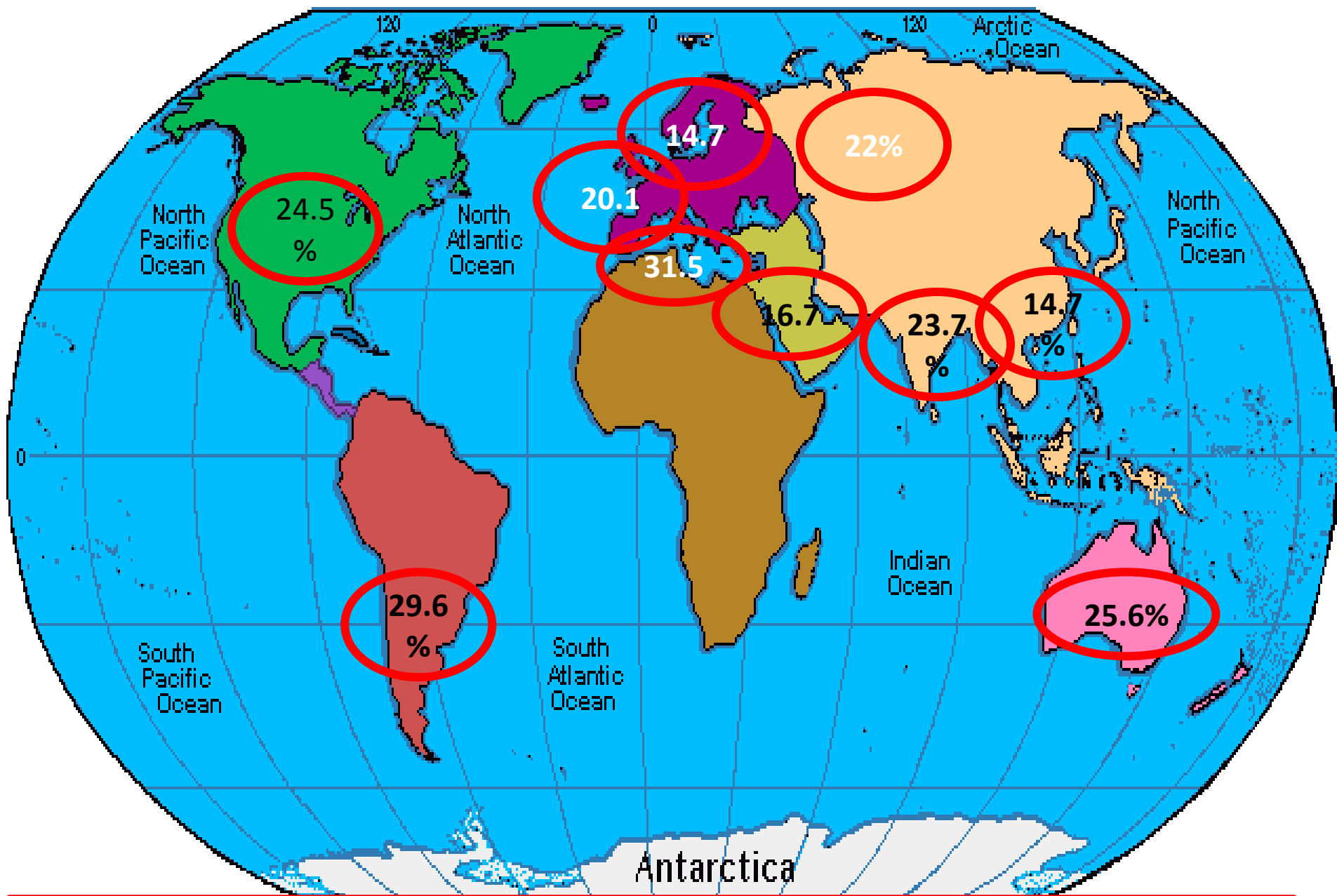
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Why AKI?

- 1- AKI is common worldwide and is encountered in multiple settings but remains poorly recognized.
- 2-AKI contributes to adverse outcomes including CKD and Mortality.
- 3-AKI is preventable, treatable, and reversible.
- 4-AKI is poorly managed .
- 5-AKI causes a societal burden .
- 6- Health-care workers are not well informed about the disease and its consequences

Agenda

- 1- What is the worldwide Incidence ?.
- 2- Difference between Community versus Hospital acquired AKI?
- 3- Incidence In Arabic countries and in Egypt.
- 5-How good are we Managing AKI?.
- 6- What are the steps to raise the awareness ?.



WORLD INCIDENCE OF AKI ; A Meta-Analysis
AKIN ADVISORY GROUP OF THE ASN. CJANS 2013

	All Studies	Studies of Adults	Studies of Children
No. of studies	154	130	24
Sample size	22 220 (95–1 126 636)	26 240 (509–1 126 636)	593 (95–3396)
Percentage of male participants	63 (28–100)	65 (28–100)	56 (49–79)
Age of participants (yr)	51.6 (0.0–80.3) ^a	60.6 (25.5–80.3)	4.7 (0.0–11.4) ^a
Studies by clinical setting			
Community acquired	7 (5)	6 (5)	1 (4)
Critical care	41 (27)	32 (25)	9 (38)
Cardiac surgery	42 (27)	35 (27)	7 (29)
Trauma	4 (2)	4 (3)	0 (0)
Heart failure	1 (1)	1 (1)	0 (0)
Hematology /oncology	3 (2)	3 (2)	0 (0)
Nephrotoxins	4 (2)	2 (1)	2 (8)
Hospital acquired, unspecified	52 (34)	47 (36)	5 (21)
Studies by continent			
Australia and New Zealand	9 (6)	9 (7)	0 (0)
Asia	21 (14)	18 (14)	3 (13)
Europe	51 (33)	45 (35)	6 (25)
Africa	0 (0)	0 (0)	0 (0)
Multiple continents	3 (2)	3 (2)	0 (0)
Studies by world zone ^b			
Australia and New Zealand	9 (6)	9 (7)	0 (0)
Eastern Asia	17 (11)	15 (12)	2 (8)
Western Asia	2 (1)	1 (1)	1 (4)
Southern Asia	2 (1)	2 (2)	0 (0)
South East Asia	0 (0)	0 (0)	0 (0)
Eastern Europe	2 (1)	1 (1)	1 (4)
Western Europe	15 (10)	13 (10)	2 (8)
Northern Europe	12 (8)	10 (8)	2 (8)
Southern Europe	18 (11)	17 (13)	1 (4)
North America	64 (42)	50 (38)	14 (60)
North Africa	0 (0)	0 (0)	0 (0)
Western Africa	0 (0)	0 (0)	0 (0)
Multiple zones	3 (2)	3 (2)	0 (0)
Studies by latitude			
North	138 (89)	115 (88)	23 (96)
South	15 (10)	14 (11)	1 (4)
North and South	1 (1)	1 (1)	0 (0)
Country income classification			
Low income	1 (1)	1 (1)	0 (0)
Lower middle income	1 (1)	1 (1)	0 (0)
Upper middle income	20 (13)	16 (12)	4 (17)
High income	130 (84)	110 (85)	20 (83)
Not available	2 (1)	2 (1)	0 (0)
Country total health expenditure (% of GDP) ^d			
<5	8 (5)	7 (5)	1 (4)
5–10	68 (45)	58 (45)	10 (42)
>10	76 (49)	63 (48)	13 (54)
Not available	2 (1)	2 (2)	0 (0)

Data are presented as the mean (range) or *n* (%). KDIGO, Kidney Disease Improving Global Outcomes; GDP, gross domestic product.

^aA zero value indicates newborns.

^bAccording to the United Nations geo-scheme classification (11).

^cAccording to the World Bank's classification of income of countries (12).

^dAccording to the World Health Organization (14).

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Table 2. Pooled incidence rate of AKI according to the KDIGO-equivalent definition

Subgroup	Studies (n)	Patients (n)	Patients with AKI (n)	AKI Incidence Rate (%)	95% Confidence Interval	Test for Heterogeneity	
						I ² Index	Q Test P Value
All	154	3,585,911	573,424	23.2	21.0 to 25.7	99.9	<0.001
Age category							
Adults	130	3,571,691	569,861	21.6	19.3 to 24.1	99.9	<0.001
Children	24	14,220	3563	33.7	26.9 to 41.3	98.3	<0.001
Clinical setting							
Community acquired	7	548,398	4897	8.3	1.6 to 33.0	99.9	<0.001
Hospital acquired	147	3,571,513	568,527	23.2	20.9 to 25.5	99.9	<0.001
Cardiac surgery	42	164,333	33,157	24.3	20.4 to 28.8	99.7	<0.001
Trauma	4	14,947	2557	19.9	13.6 to 28.2	98.7	<0.001
Heart failure	1	682	221	32.4	29.0 to 36.0	—	—
Hematology/oncology	3	2401	453	21.3	7.5 to 47.6	99.2	<0.001
Nephrotoxins	4	17,786	1681	12.2	6.2 to 22.7	98.7	<0.001
Hospital acquired, unspecified	52	1,948,760	257,878	20.9	17.2 to 25.2	99.9	<0.001
Continent							
Australia and New Zealand	9	523,715	182,405	25.6	22.3 to 29.3	99.9	<0.001
Asia	21	286,377	17,358	15.6	8.7 to 26.4	99.9	<0.001
Europe	51	918,068	72,390	23.1	18.0 to 29.2	99.9	<0.001
America	70	1,847,689	296,655	24.9	22.1 to 27.8	99.9	<0.001
Multiple continents	3	10,062	4616	49.4	22.9 to 76.3	99.9	<0.001
World zone ^a							
Australia and New Zealand	9	523,715	182,405	25.6	22.3 to 29.3	99.9	<0.001
Eastern Asia	17	258,161	14,794	14.7	7.0 to 28.2	99.9	<0.001
Western Asia	2	25,989	2006	16.7	3.3 to 54.3	99.3	<0.001
South Asia	2	2227	558	23.7	7.5 to 54.4	99.4	<0.001
Eastern Europe	2	2600	639	22.0	9.5 to 43.3	98.9	<0.001
Western Europe	15	161,198	14,725	20.1	12.1 to 31.5	99.9	<0.001
Northern Europe	12	607,956	8894	14.7	5.5 to 33.6	99.9	<0.001
Southern Europe	18	24,080	6546	31.5	23.1 to 41.3	99.5	<0.001
Multi-zone Europe	4	122,234	41586	32.5	28.3 to 37.0	99.6	<0.001
North America	64	1,843,814	295,554	24.5	21.7 to 27.5	99.9	<0.001
South America	6	3875	1101	29.6	19.1 to 42.7	98.3	<0.001
Multiple zones	3	10,062	4616	49.4	22.9 to 76.3	99.9	<0.001
Latitude							
North	138	3,057,543	389,454	22.6	20.2 to 25.2	99.9	<0.001
South	15	527,590	183,506	27.0	24.2 to 30.0	99.8	<0.001
North and South	1	778	464	59.6	56.2 to 63.0	—	—
Country income classification ^b							
Low income	1	1047	399	38.1	35.2 to 41.1	—	—
Lower middle income	1	1180	159	13.5	11.6 to 15.5	—	—
Upper middle income	20	248,718	14,335	19.5	10.4 to 33.7	99.9	<0.001
High income	130	3,313,430	553,203	23.8	21.4 to 26.4	99.9	<0.001
Not available	2	21,536	5328	25.1	23.6 to 26.7	80.4	0.02
Country's gross domestic expenditure (% of GDP) ^c							
<5	8	222,178	7823	14.5	7.2 to 26.9	99.8	<0.001
5–10	68	1,406,796	258,636	22.3	19.6 to 25.3	99.9	<0.001
>10	76	1,935,401	301,637	25.2	22.3 to 28.3	99.9	<0.001
Not available	2	21,536	5328	25.1	23.6 to 26.7	80.4	<0.001

KDIGO, Kidney Disease Improving Global Outcomes; WHO, World Health Organization; CJASN, Clinical Journal of the American Society of Nephrology; Vol 8 September, 2013.

^aAccording to the United Nations geo-scheme classification (11).

^bAccording to the World Bank's classification (12).

^cAccording to the World Health Organization (13).

WORLD INCIDENCE OF AKI ; A Meta-Analysis

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Incidence of hospital- and community-acquired AKI in the world

Reference	Location	Study features	Incidence	Change in incidence over time
Hospital-acquired AKI in the developed world				
Hou <i>et al.</i> ⁹⁹	USA	2262 Adult admissions	4.9% Of admissions	NA
Nash <i>et al.</i> ¹⁰⁰	USA	4622 Adult admissions	7.2% Of admissions	NA
Waikar <i>et al.</i> ¹⁰⁰	USA	Nationwide sample of 5,563,381 adults discharged 1988 to 2002	61–288 Per 100,000 head of population	4.7 Times increase
Xue <i>et al.</i> ¹⁹	USA	Nationwide sample of 5,563,381 adults who required dialysis discharged 1988 to 2002	4–27 Per 100,000 head of population	6.8 Times increase
Uchino <i>et al.</i> ¹⁸	International	5,403,015 Adults discharged between 1992 and 2001 from Medicare database	23.8 Per 1000 hospital discharges	11% Per year increase
		Multicenter study 1738/29,269 ICU patients in 23 countries between 2000 and 2001	5–6% Of ICU admissions; 80% received dialysis	NA
Hospital-acquired AKI in LMI countries				
Abraham <i>et al.</i> ¹⁰¹	Kuwait (400,000 inhabitants)	77 Adults admitted to university hospital in 1984–1986	5.4 per 100,000 head of population per year	NA
Jha <i>et al.</i> ^{23,102}	North India	190 Of 29,503 adults presenting to a referral center in 1-year period	6.4 Per 1000 admissions per year	NA
Thomas <i>et al.</i> ¹⁰³	Sao Paulo, Brazil	Review of adult inpatients	5.0 Per 1000 admissions	NA
Al-Homrany <i>et al.</i> ¹⁰⁴	Trinidad and Tobago	AKI after 205 cardiac surgeries in 1993–1997	21 Per 1000 surgeries	NA
Kohli <i>et al.</i> ¹⁰⁵	Saudi Arabia	26,000 Adults in 2-year period	3.7 Per 1000 admissions	NA
Wang <i>et al.</i> ^{106,107}	Chandigarh, India	294/33,301 Admissions at large urban center in 1-year period	2.1 per 1000 admissions	NA
	Peking, China	Retrospective review 225,000 inpatients at a university center in 1994–2003	0.36 Per 1000 admissions	1.06 Times increase over 5 years

The worldwide incidence rate of acute kidney injury is still poorly known

Abbreviations: A/CKD, acute kidney injury superimposed on chronic kidney disease; AKI, acute kidney injury; CKD, chronic kidney disease; ICU, intensive care unit; LMI countries, low- and middle-income countries; NA, not applicable; PMP, per million population; RIFLE, Risk, Injury, Failure, Loss, and End-stage kidney disease; SCr, serum creatinine.

Modified from Cerda *et al.*⁸

	Community acquired	Change in incidence	Hospital acquired	Change in incidence
HI countries	200 PMP	51–62%	60–288/ 100,000 Pop	6.8 Times increase; 11%/year increase
LMI countries	20 PMP	No significant change	5.4/100,000 Pop	1.06 Increase over 5 years

Incidence

- 1)- Underreporting , wide disparity in reported incidence rates.
- 2)- Regional disparities.
- 3)-Differences in definition. (more than 35 definitions of AKI (formerly acute renal failure) in literature!

Jorge Cerda et al ., *Clin J Am Soc Nephrol* 2008

CA-AKI :It affects between 7 and 18% of hospital inpatients and ranges from 20 to 200 per million population in the community.

HA-AKI:Exceeds that of community-acquired ARF by 5–10 times.

Thomas M, *SNephrol Dial Transplant* 2011.

Incidence in Developing countries

- The place of residence of more than **50% of the world's population**.
- A paucity of information on the prevalence, course, and outcomes of AKI in low- and middle-income (LMI) countries contributes to a somewhat biased view of AKI as a disease of hospitalized patients.
- No nationwide collection systems are available, and data from isolated centers are not based on the current AKI definition.
- **Difficulties ?????**
- AKI is that the majority of patients who develop AKI never make it to large reporting centers.
- The condition is underrecognized.
- Distances are enormous .
- The costs of transportation.
- Delayed referral .

AKI ; Causes

Volume-responsive “prerenal”

The majority of causes of AKI in children around the world
A- Acute diarrheal losses and renal hypoperfusion after major surgery and secondary to systemic sepsis .

*Bailey D. et al., *Pediatr Crit Care Med*, 2007*

B-Hemolytic uremic syndrome (HUS) is the chief cause of CKD and ESRD in children in Argentina and in northern India.

*Rivero MA, et al. *Medicina (B Aires)* 2004*

In Argentina the mortality associated with HUS has decreased from 10 to 3% (84), in India, it remains high (up to 59%, attributed often to late referral of patients .

*Rivero MA, et al. *Medicina (B Aires)* 2004*

Drugs

between 18% and 33%.

Antibiotic associated

ACE or ARBs in highrisk patients, and heart failure. Drugs (particularly nonsteroidal anti-inflammatories).

Medicines prescribed by traditional healers— herbs and unidentified chemicals constitute a unique class of nephrotoxins in Africa and Asia.

*Jha V and Chugh KS *Semin Nephrol*(2003)*

Obestatreic

The incidence of obstetric-related ARF has declined over the years.

*Barsoum RS .*Contrib Nephrol* 2004*

Disasters

Earthquake , Crush syndromes accidents, rhabdomyolysis (from infections, coma, seizures).

Chemicals

Accidental exposure in industrial work places (e.g. to chromic acid) or use with suicidal or homicidal intent (e.g. of copper sulphate, or ethylene glycol).

In tropical areas

Diarrheal diseases, hemolysis, tropical and non-tropical infections, and viper snakes, sea snakes snake bites stinging insects ,and raw gallbladder and bile of carp and sheep. are still common causes of ARF.

The changing epidemiology of acute renal failure

Norbert Lameire . NATURE CLINICAL PRACTICE NEPHROLOGY JULY 2006

HEMATOPOIETIC PROGENITOR CELL

- ARF is extremely common.
- incidences r:
 - 6.5% in some autologous HPCT series. through 26–64% in most series
Gruss E et al. (1995) Am J Nephrol , Zager RA (1994). Kidney Int
 - 81% in allogeneic transplantation settings.
Parikh CR et al. (2002) idney Int
- Patients undergoing myeloablative HPCT had 4.8-fold greater incidence of ARF than nonmyeloablative HPC (73% versus 47%) with a fourfold greater need for dialysis.

SOLID ORGAN TRANSPLANTATION ASSOCIATED

- 22% of liver
- 35% of heart
- 15% of lung transplant recipients.
- RRT was required by 7.5% of liver and 10.6% of heart transplant recipients, and was associated with increased mortality.
Wyatt CM and Arons RR (2004) Transplantation
- AE:
 - Underlying cardio pulmonary or hepatic failure
 - Pre-existing renal insufficiency
 - Hemodynamic effects of extensive surgery
 - Nephrotoxic effects of the calcineurin inhibitors ciclosporin , and tacrolimus.

Developing countries Versus developed world

Aetiology

- **Acute GN** : The incidence of acute glomerulonephritis, both primary and secondary to infectious diseases appears to be higher than in developed countries.
 - Turkey, more than 60% of childhood cases of AKI

Bircan Z, et al. *Pediatr Nephrol* 14: 87–88, 2000

Gender disparities

- in certain regions in Africa and India, boys are more than twice as likely as girls to be taken by their parents to see medical personnel. **(being a female child is a risk factor for worse AKI survival)**.
- Gender disparity is also expressed in the development of AKI after septic abortion.
- Being poor and Black worsens the survival of disease in Africa and America.

Phadke KD, Dinakar C.: *Perit Dial Int* 2001

Martins D, Agodoa L, Norris K. *Int J Nephrol* 2012



INFECTIONS

- **Human immunodeficiency virus:**
- Before the introduction of highly active antiretroviral therapy (HAART), fluid–electrolyte and acid–base disturbances were major risk factors for the development of ARF in people with AIDS.
- HIV patients with ARF are **younger** and much more seriously ill than other patients with ARF.
- **ATN secondary to ischemic and toxic injuries** is the commonest form in HIV patients.
- In AIDS patients with complicated infections and multi-organ failure, ATN is a terminal event.
- Others have a good prognosis if ARF is treated aggressively.

Franceschini N et al. (2005) *Kidney Int*

Malaria

- Each year, 300 million people contract the disease, which will be responsible for more than **1 million** yearly deaths in Africa alone .
- ARF complicates *Plasmodium falciparum* **malaria** in fewer than **1.0–4.8%** of native patients in endemic areas.
- Early intervention: appropriate antimalarial treatment and renal replacement therapy, is associated with improved survival
- **Imported malaria'** With increasing rates of immigration to Europe and North America, 'has imposed itself on the differential diagnoses lists of many medical conditions.
- A study in France reported **AKI in 31%** of patients admitted with imported malaria.



Badiaga S et al. (2005) J Emerg Med.

Developing countries Versus developed world

- **1- Age:**
- AKI is often a disease of **the young**.
- Whereas in **developed regions elderly patients** predominate .

Waikar SS, J Am Soc Nephrol 2006

- **2- Mortality:**
- lower than in developed countries .

Utas C, et al., Nephrol Dial Transplant 2000 .

- **2-Seasonal variations** in incidence:
- During the monsoon season in Southeast Asia, the incidence of AKI may increase by **18 to 24%** as a result of the increase in new cases of malaria, leptospirosis, acute gastroenteritis, and dysentery .

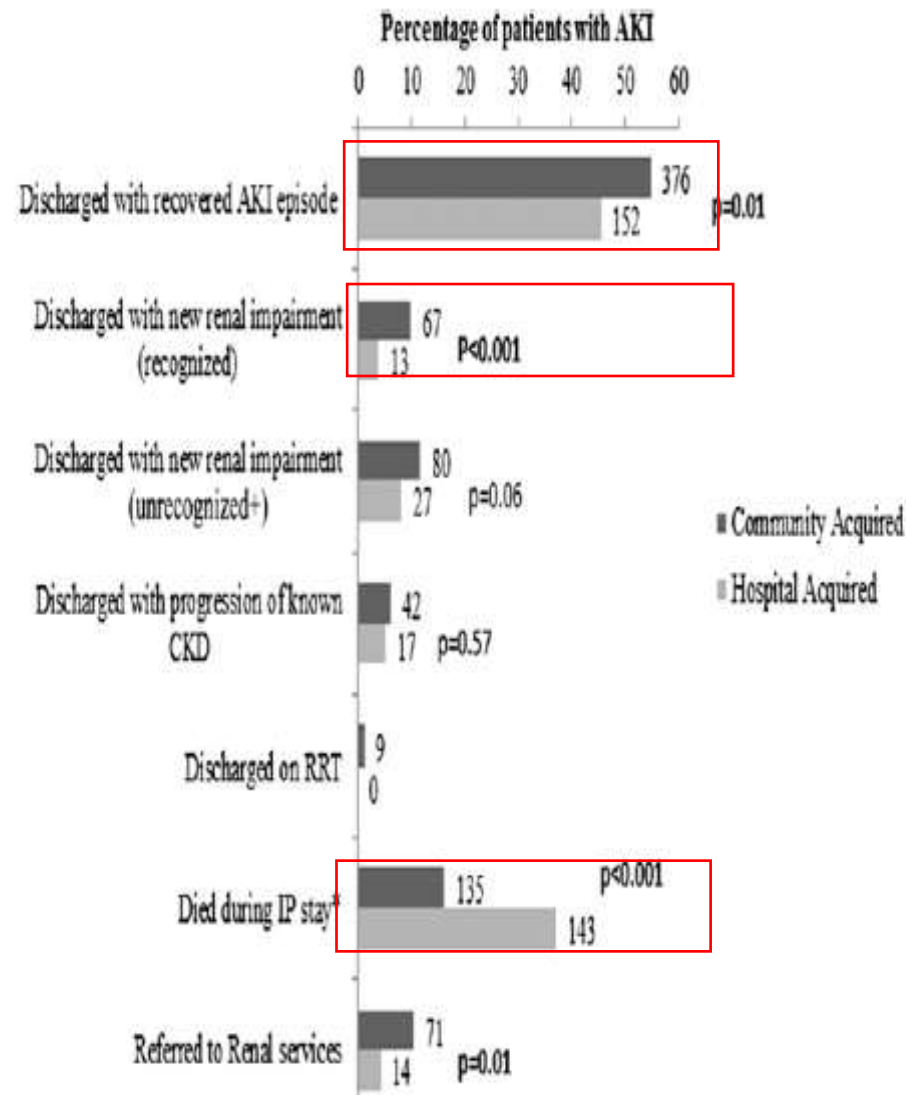
Chitalia VC, Kidney Int 2002.



Hospital-acquired AKI

- **A remarkable increase in the incidence of hospital-acquired ARF has been observed over the past decades.**
- **1- Increasing age of the population.**
- **2- Multiple comorbidities of the hospitalized population.**
- **3- Increased prevalence of risk factors for ARF such as chronic kidney disease and diabetes.**
- **4- More widespread use of intravenous contrast agents for imaging and cardiovascular procedures.**

- More patients with CA-AKI showed:
- **1- Recovery of renal function** while an inpatient compared with the HA-AKI group (54.8% versus 45.5%; $P=0.01$).
- **2-More likely to be labeled as having de novo CKD** at the point of discharge compared with patients with HA-AKI (9.8% versus 3.9%; $P=0.001$).
- **3- lower inpatient mortality** (19.6% versus 42.8% in HAAKI group; $P,0.001$).
- **4- Shorter length of hospital stay .**
- **5- There were no significant differences between the numbers of patients requiring in-patient RRT**



Acute kidney injury



2013
USRDS
ANNUAL
DATA
REPORT

Patients characteristics

Age

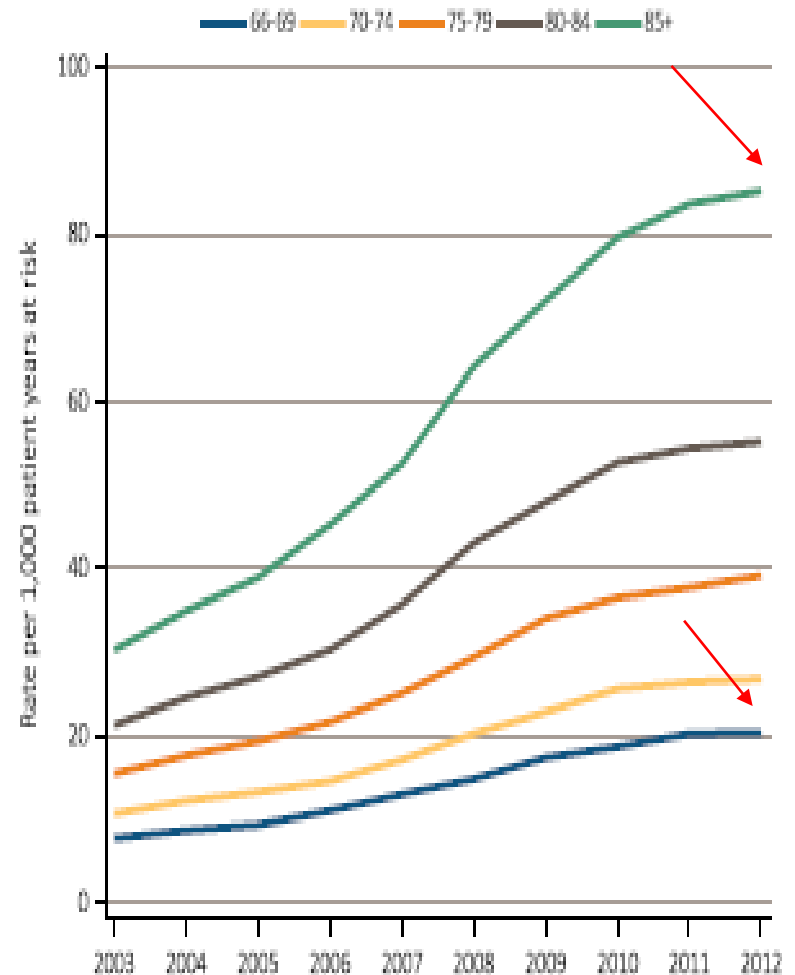
patients aged 80 years and older comprise nearly 55 percent of all patients with an AKI hospitalization .

Males continue to make up a slight majority of AKI cases, a steady trend observed since 2003.

AKI rates are significantly associated with aging,

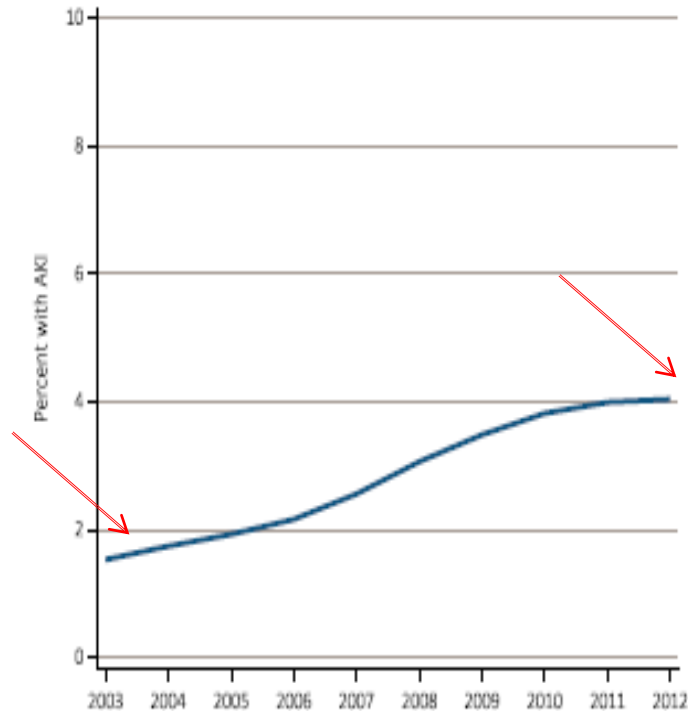
20.4 per 1,000 patient years in patients aged **66-69** to **85.2** per 1,000 patient years among patients older than **85 years**.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Age										
66-69	10.6	10.5	10.3	10.6	10.6	10.3	10.9	10.8	11.3	11.3
70-74	16.5	16.3	16.0	15.3	15.4	15.5	15.4	15.6	15.6	15.8
75-79	21.8	21.3	21.0	20.2	19.4	18.5	18.6	18.0	17.7	18.0
80-84	22.5	22.9	22.9	22.3	22.4	22.4	21.5	21.3	20.7	19.9
85+	28.6	29.0	29.9	31.6	32.1	33.4	33.7	34.3	34.7	34.9
Sex										
Female	47.9	48.0	47.7	48.1	47.8	47.8	47.8	47.5	47.7	48.2
Male	52.1	52.0	52.3	51.9	52.2	52.2	52.2	52.5	52.3	51.9

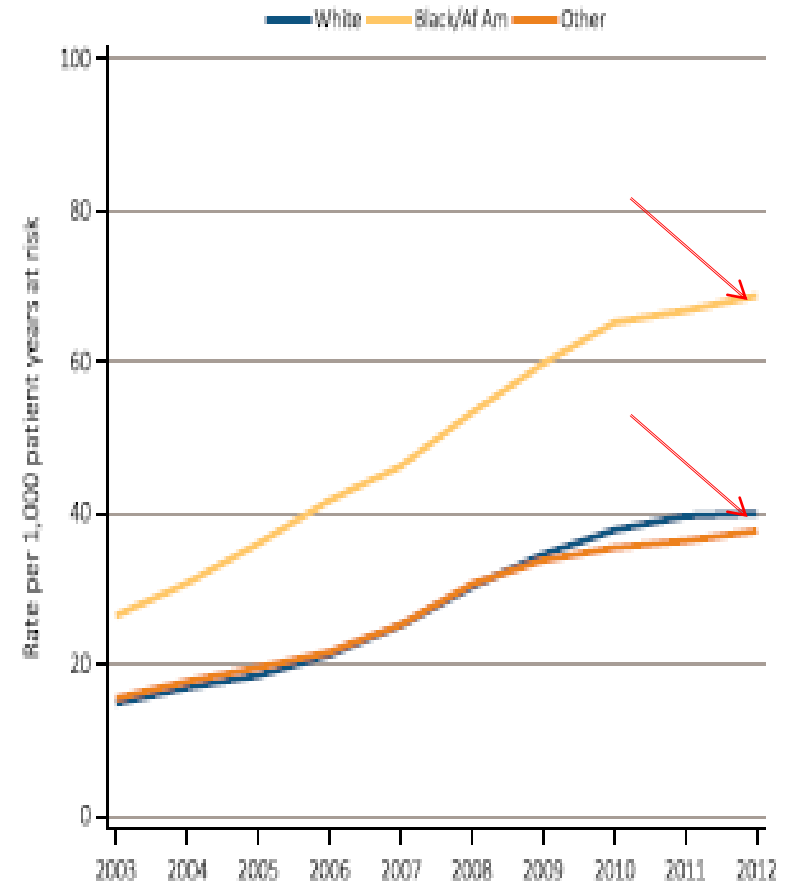


Patients characteristics

Hospitalization/ Race



The percent of patients with an AKI hospitalization appears to be rising, now reaching **4 percent annually** compared to **1.5 percent** a decade ago.



The incidence rate reached **68.8 per 1,000 patient years at risk** in Blacks/African Americans VS **40.1** and **37.7**, in Whites and individuals of other races.

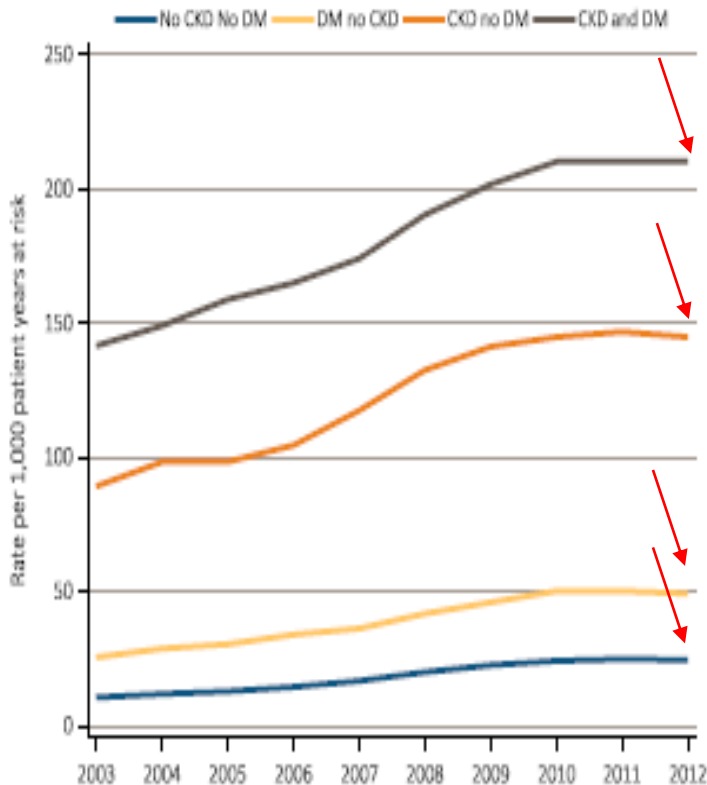
USRS/Patients characteristics underlying comorbidity.

NDM, non-CKD : 24.8 per 1,000 patient years patients.

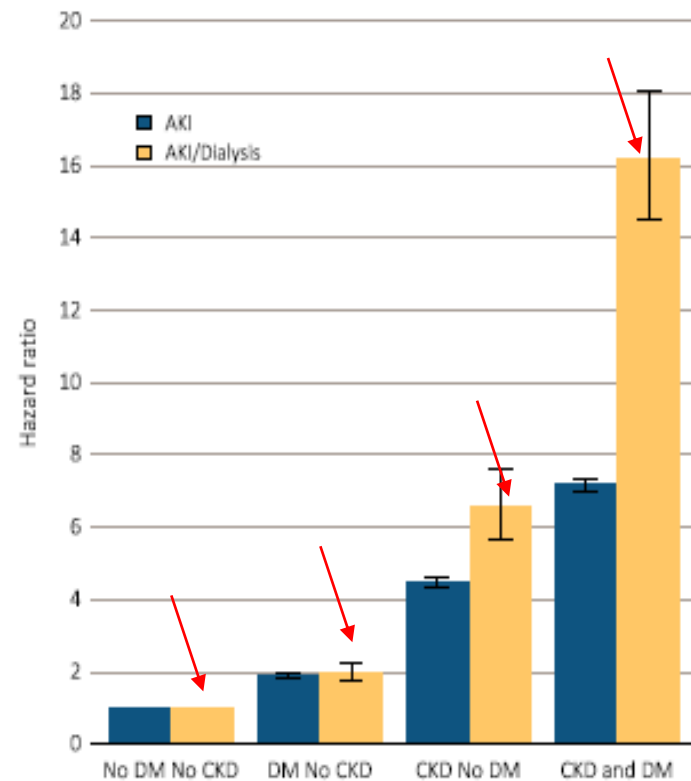
DM : had an AKI incidence rate of 49.5 per 1,000 patient years.

CKD of 145.0 per 1,000 patient years,

DM and CKD was 210.3 per 1,000 patient years.



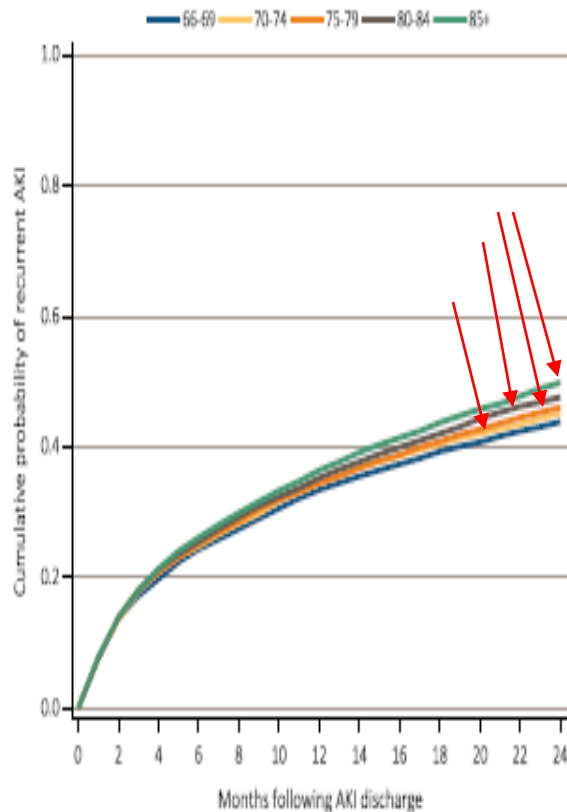
The hazard ratios were even more pronounced for AKI requiring dialysis.



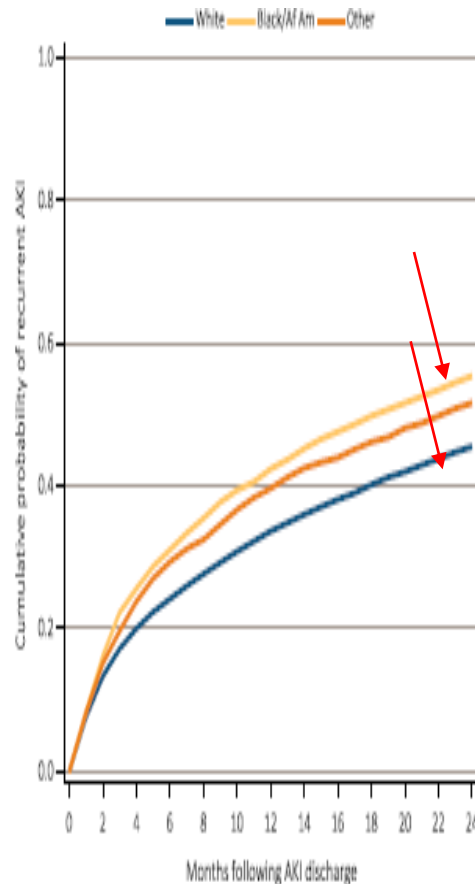
USRS/Patients characteristics

Probability of a recurrent AKI event

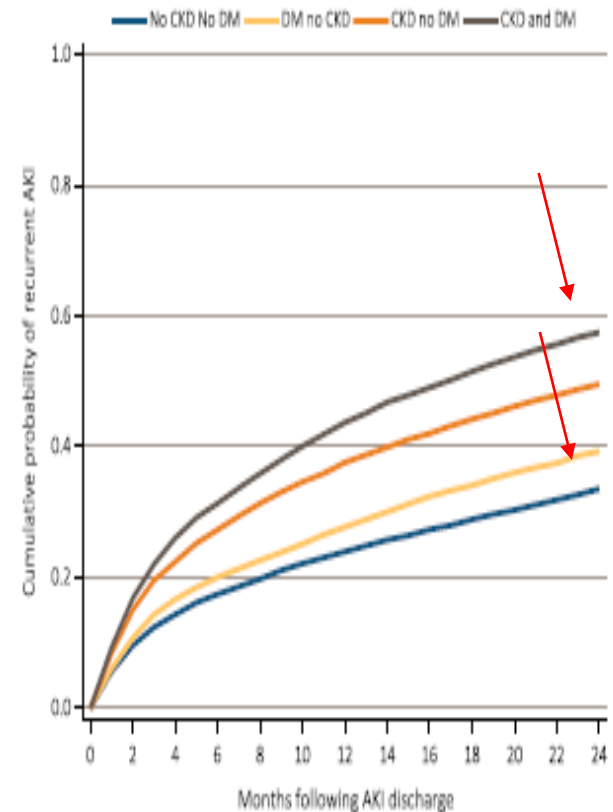
In contrast to first episodes, the rate of recurrent AKI is relatively similar across age groups



Blacks/African Americans are more likely to have a recurrent AKI hospitalization than other races, with a probability of 0.55 at 24 months .



Having either DM or CKD is associated with an increased probability for recurrent AKI compared to having neither .

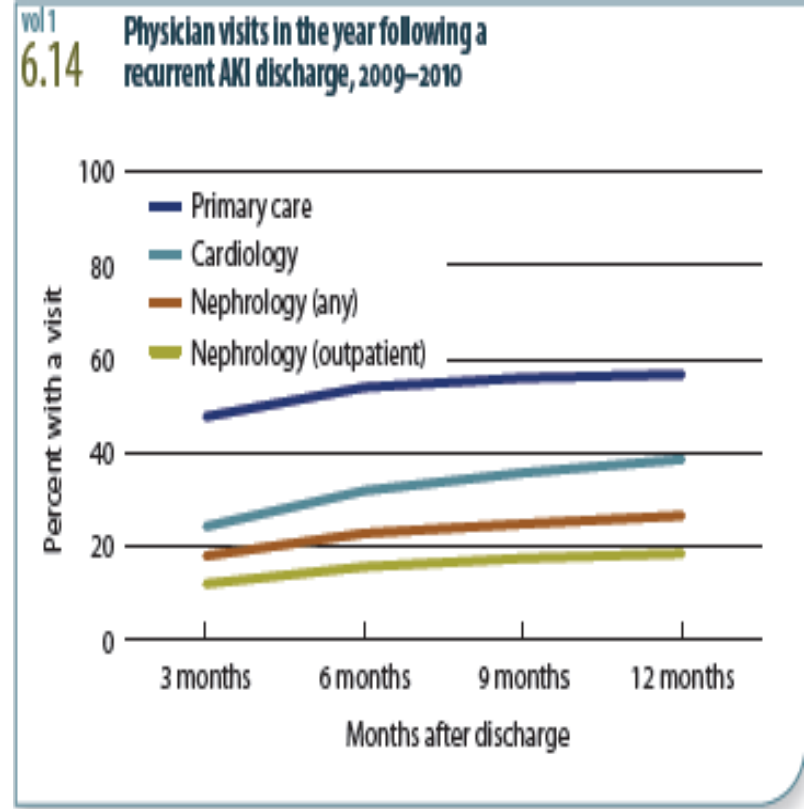
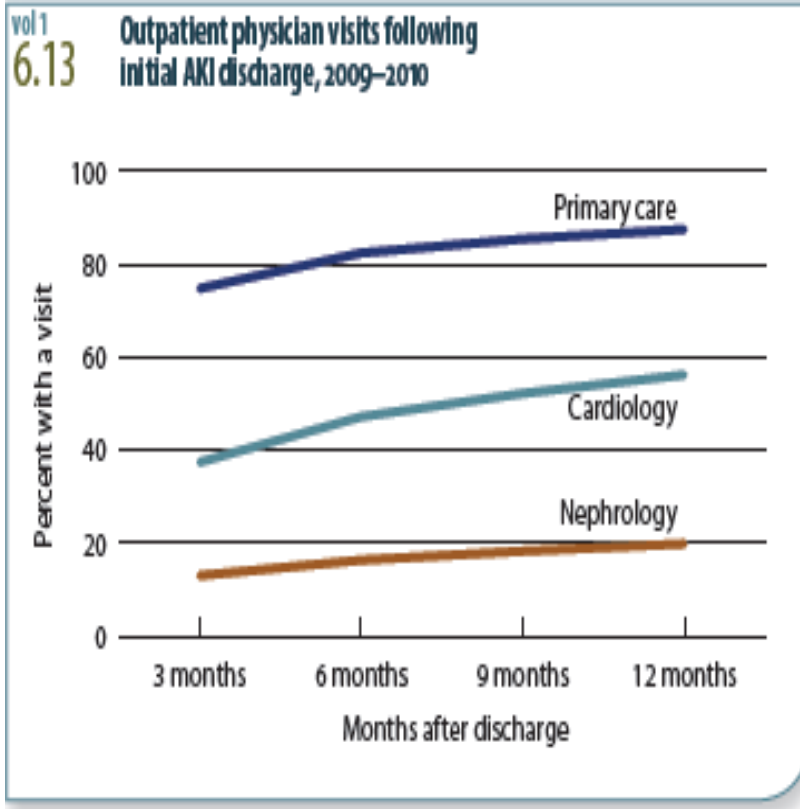


USRDS

Patient Care

Following an AKI hospitalization, 75 percent of patients see a primary physician within three months of discharge, while 38 and 13.2 percent, respectively, see a cardiologist or nephrologist.

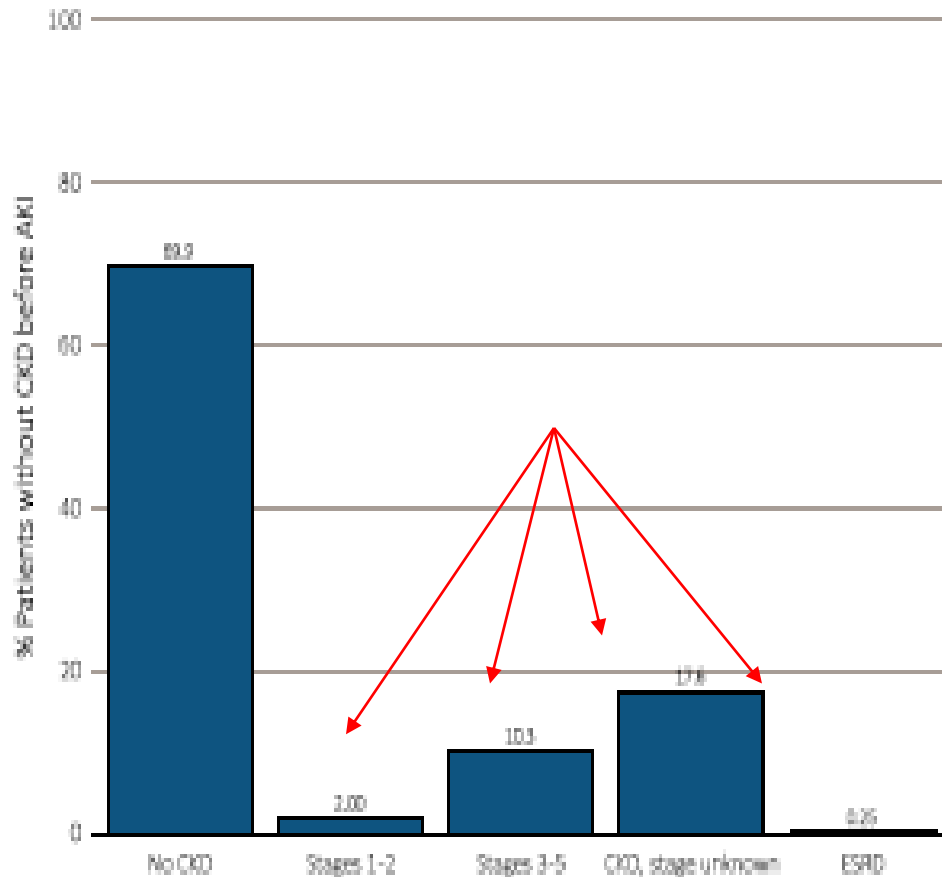
Fewer than half of the patients with a recurrent AKI see a primary care physician within three months of their second discharge, while 24.4 percent see a cardiologist and 18.1 see a nephrologist .



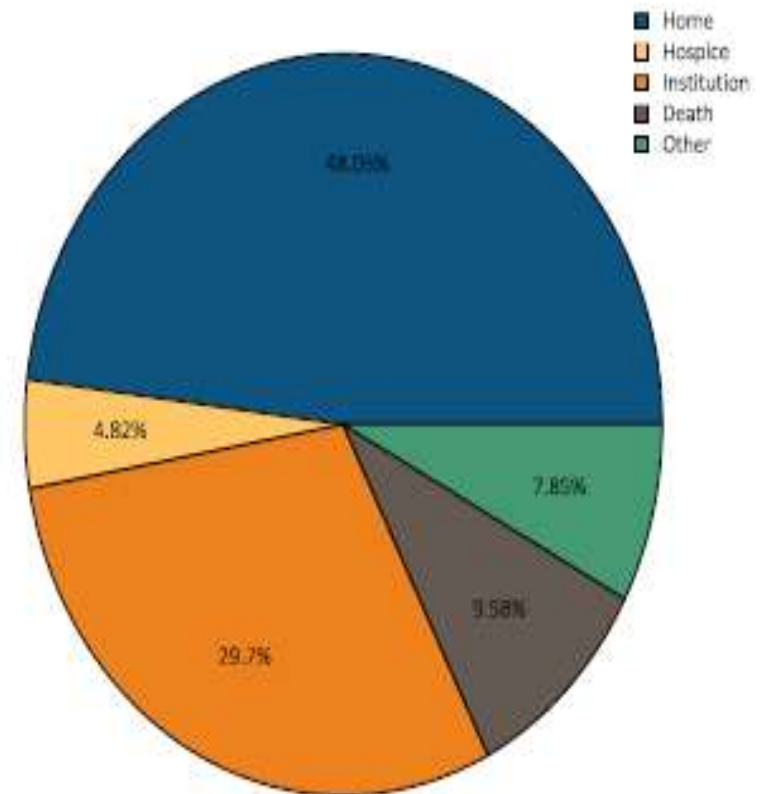
USRDS

Changes in CKD Status After Acute Kidney Injury

Among patients without baseline CKD, nearly 30 percent are reclassified as having some degree of CKD, including 0.25 percent being declared ESRD.



50 percent were discharged to their home. Mortality (including discharge to hospice) was 14.4 percent,



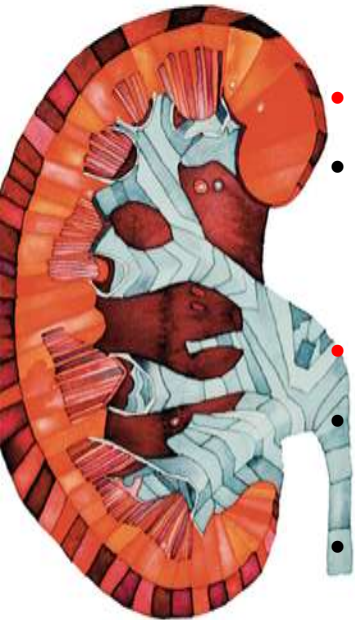
How good are we Managing AKI ?



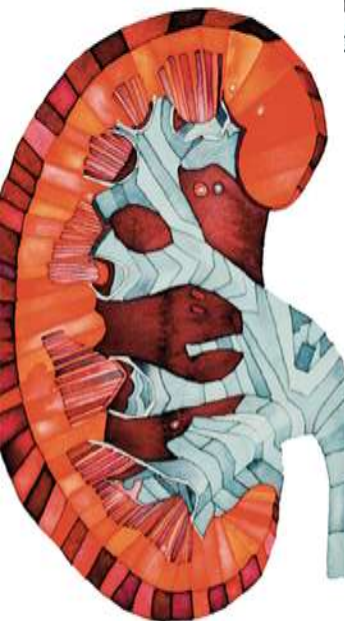
Adding Insult to Injury

A review of the care of patients who died in hospital with a primary diagnosis of acute kidney injury (acute renal failure).

Key findings

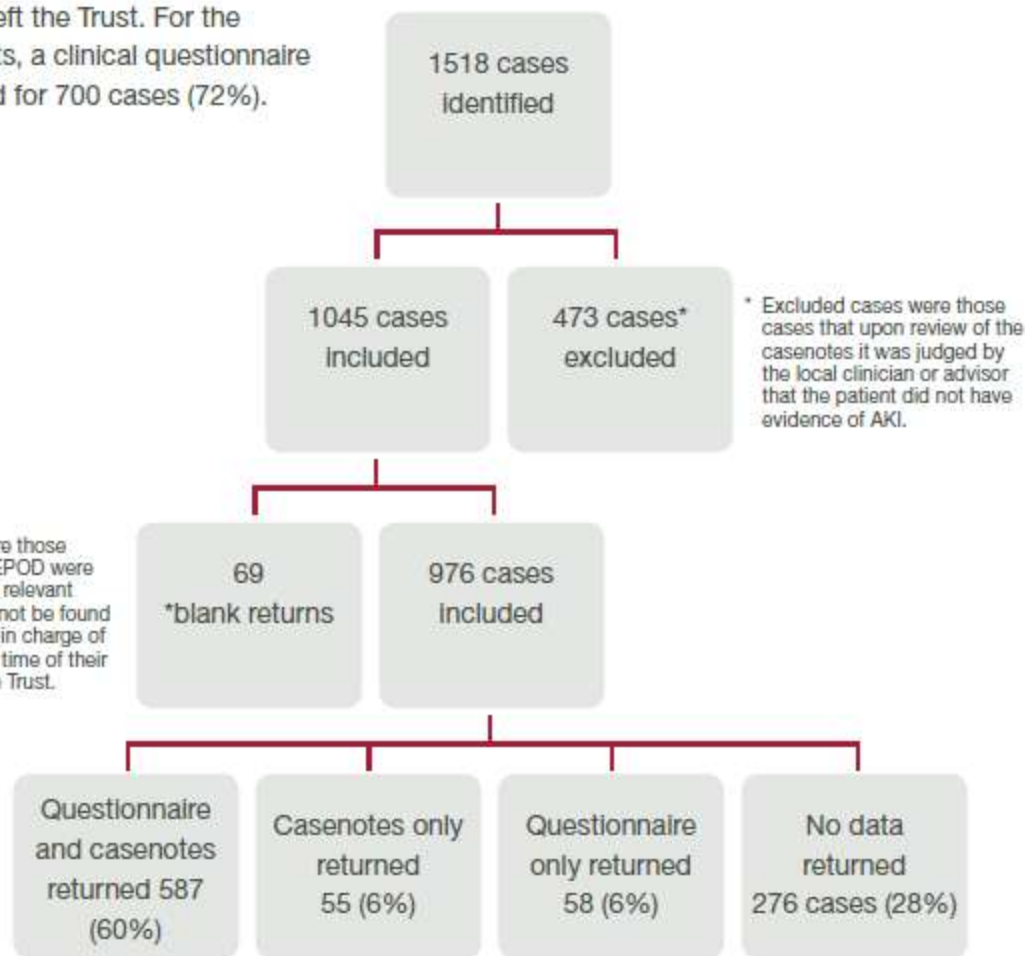


- **The primary aim :**
 - To examine the process of care of patients who died in hospital with acute kidney injury (AKI), in order to identify remediable factors in the care received by these patients.
- **Hospital participation**
 - National Health Service hospitals in England, Wales and Northern Ireland .
 - Hospitals in the independent sector and public hospitals in the Isle of Man, Guernsey and Jersey.
- **Study population**
 - Patients aged 16 years or older inclusion if they were coded for a diagnosis of AKI and subsequently died in hospital **between January 1st 2007 and March 31st 2007 inclusive.**



For the 69 cases the casenotes were reported for the consultant in charge of the patient at the time of their death had left the Trust. For the included patients, a clinical questionnaire was received for 700 cases (72%).

Figure 2.1 Data returns



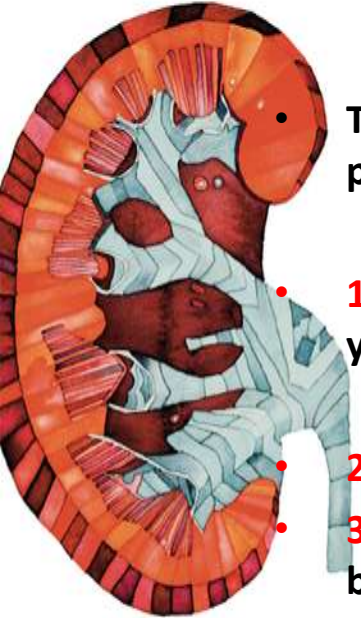
Life and Death

Questionnaires and casenotes



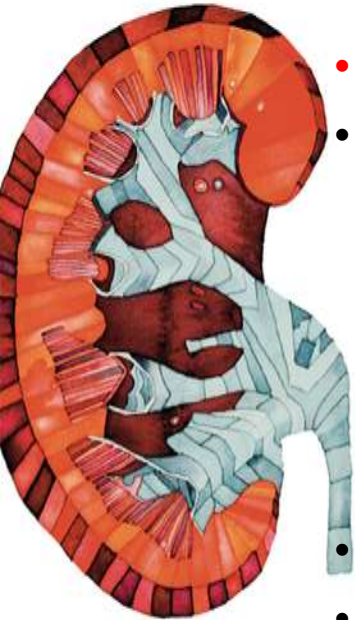
- There were two questionnaires used to collect data
- **1. Clinical Questionnaire :**
- This questionnaire was sent to the **consultant caring for the patient** at the time of death.
- **2. Organisational questionnaire**
- This questionnaire concerned data on **the staff, facilities and protocols, relevant to the management of AKI**, for each participating hospital.
- **3. Casenotes**
- For each case to be peer reviewed selected photocopies of casenote extracts were requested.
- **Advisor group**
- After being anonymised each case was reviewed by one advisor within a multidisciplinary group.

Grading system

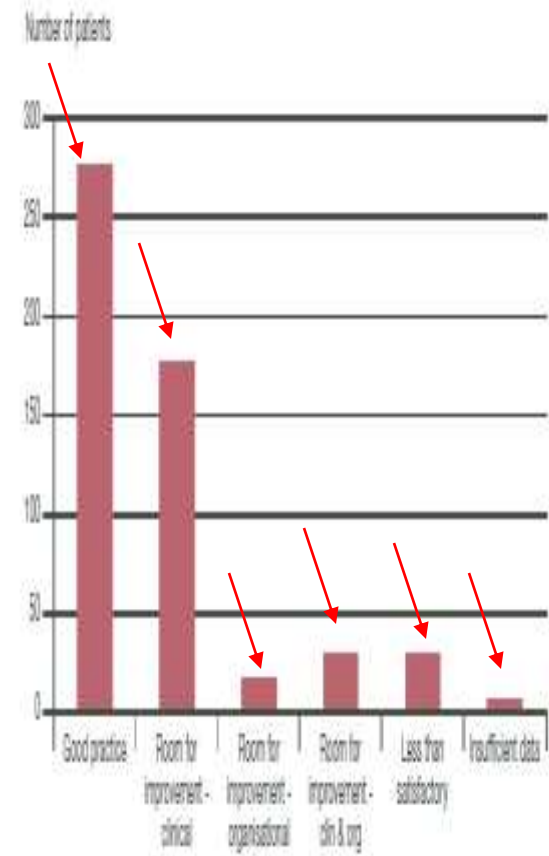


- The following grading system was used by the advisors to grade the overall care each patient received.
- **1- Good practice:** A standard that you would accept from yourself, your trainees and your institution.
- **2- Room for improvement: Aspects of clinical care** that could have been better.
- **3- Room for improvement: Aspects of organisational** care that could have been better.
- **4- Room for improvement: Aspects of both clinical and organisational care** that could have been better.
- **5- Less than satisfactory:** Several aspects of clinical and/or organisational care that were well below that you would accept from yourself, your trainees and your institution.
- **6- Insufficient information submitted to NCEPOD to assess the quality of care.**

Overall assessment of care

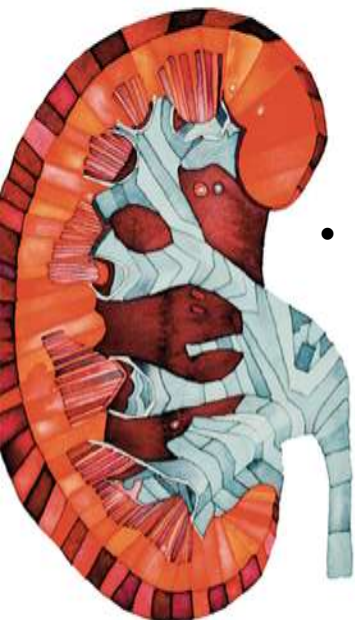


- **50%** of AKI care considered **good practice**.
- The majority of patients who received less than good care were more often judged to have room for improvement in **clinical rather than organisational care** suggesting deficiencies in AKI care are primarily related to the **clinicians managing** those patients and not deficiencies in process or material.
- This may indicate :
 - A lack of awareness of the inherent risk of AKI amongst hospitalised patients
 - A poor understanding of the pathophysiology of the condition.
 - Inadequate knowledge of its management amongst medical staff.
- **This reflects deficiencies in training, both at undergraduate and postgraduate level**

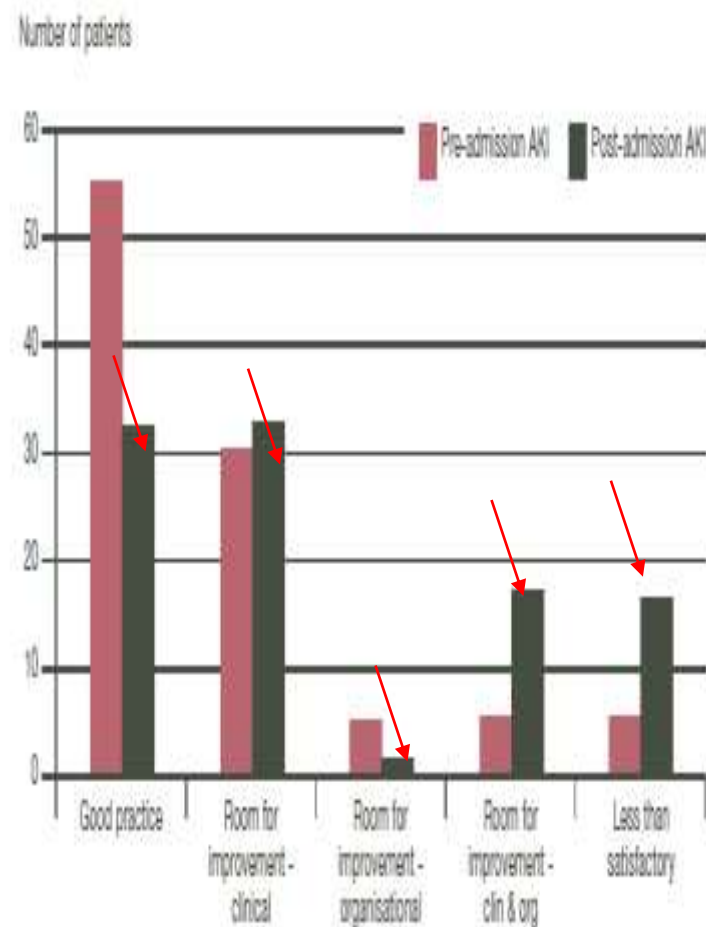


Key findings

National Confidential Enquiry into Patient Outcome and Death



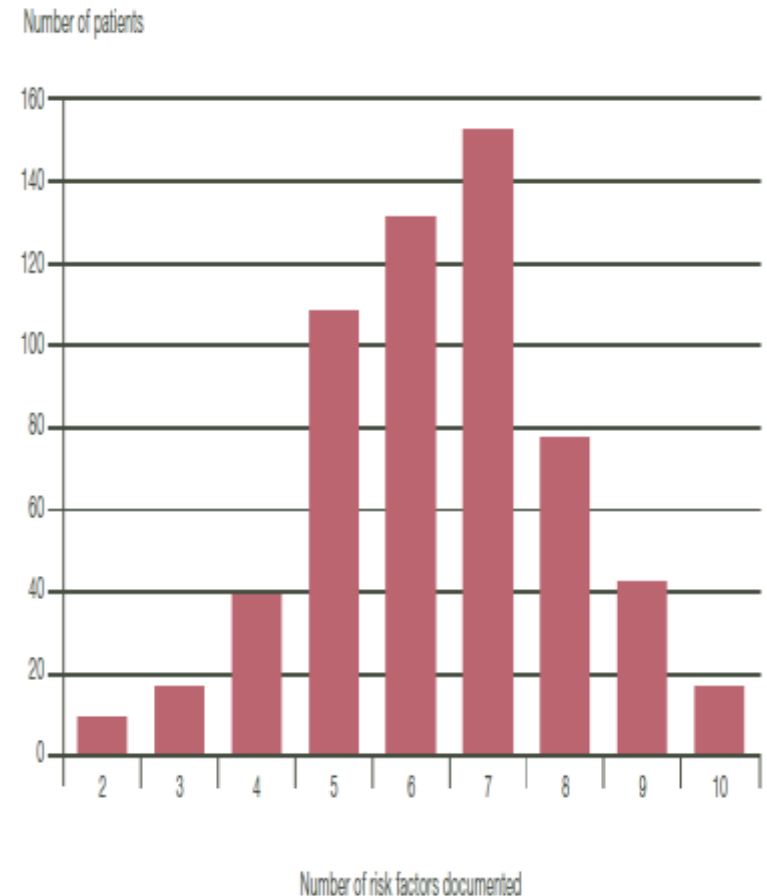
- When the overall quality of care within the study group was further broken down into those who developed AKI pre- and post-admission it can be seen that there was far more evidence of less than good practice in the post-admission AKI patients with only a **third (34/107)** receiving good care as judged by the advisors.



Risk assessment

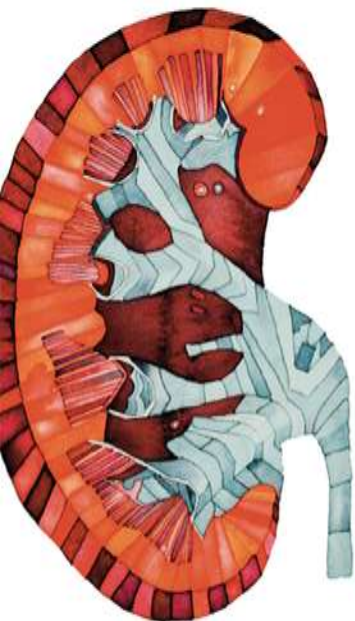
Table 4.7 Expert group 'top ten' risk factors

AKI risk factor	
1	Age
2	Co-morbidity
3	Medication
4	Previous chronic kidney disease
5	Hypovolaemia
6	Sepsis
7	Biochemistry
8	Urinalysis
9	Weight
10	Nutritional status



- **29% of patients did not have an adequate assessment or documentation of the most important risk factors for AKI**

Renal services



- **More than half of acute** admitting hospitals did not have onsite nephrologists **(54%)**.
- **(39%)** of all hospitals without nephrologists, the nearest nephrologist was in a different city.
- Not all hospitals have access to ultrasound scanning of the renal tract out of hours or at the weekend.

• Renal replacement therapy:

- **12%** patients received RRT.
- **36 /427 (8%)** of the patients who did not receive RRT the advisors judged that **should have received RRT** as part of their treatment plan.

Referral to Nephrologist

Referral to a nephrologist		Timely referral and correct advice	
	Number of patients (%)	Overall assessment of care - advisors' opinion	Number of patients (%)
Yes	181 (32)	Good practice	77 (69)
No	391 (68)	Room for improvement - clinical	20 (18)
		Room for improvement - organisational	5 (5)
Subtotal	572	Room for improvement - clinical & organisational	5 (5)
Not answered	20	Less than satisfactory	4 (4)
Total	592	Total	111

(21%) referrals were considered by the advisors to be delayed.

(20%) patients who were not referred should have been referred for advice and support in the view of the advisors.

- the patients who were referred in a timely manner, In this group the advisors judged that there was a much higher percentage of good practice (slightly over two thirds).

Investigations

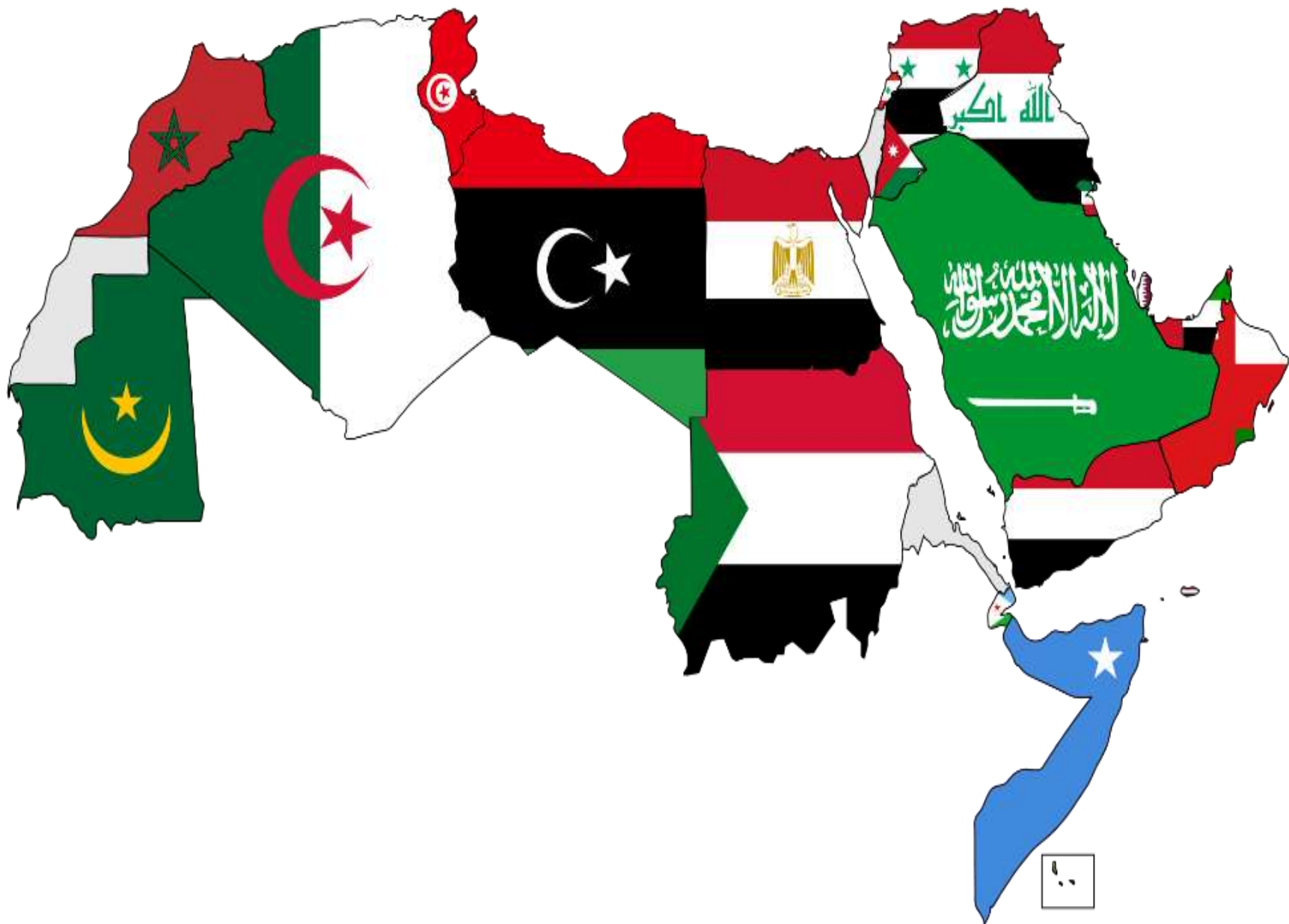
33% patients had inadequate investigations

There were 515 omissions noted, an average of almost three omissions per patient

The omissions were basic clinical examination and simple laboratory tests.



Omitted from investigations	Number of patients
Ultrasound	94
Acid base balance	83
Volume status	76
Urinalysis	73
Early warning score	57
Sepsis recognition	48
Biochemistry	33
Other	18
TPR	16
Immunology	10
CT	5
Radioisotopes	1
Renal biopsy	1
Total	515



Epidemiology of acute renal failure in hospitalized patients: experience from southern Saudi Arabia

M. Al-Homrany¹

Table 1 Distribution of acute renal failure cases by age and sex

Age group (years)	Male		Female		Total	
	No.	%	No.	%	No.	%
<20	5	5.7	1	1.6	6	4.0
20-44	26	29.5	13	21.0	39	26.0
45-59	12	13.6	7	11.3	19	12.7
60+	45	51.1	41	66.1	86	57.3
Total	88	58.7	62	41.3	150	100.0

Table 2 Profile of acute renal failure (ARF) cases by associated medical diseases, place of initiation and primary cause

Variable	No. of cases	% (n = 150)
<i>Associated disease</i>		
None	87	58.0
Cardiac	24	16.0
Diabetes	23	15.3
Hepatic	16	10.7
<i>Place of initiation</i>		
Hospital	93	62.0
Medical ward	(48)	(51.7)
Surgical ward	(26)	(17.3)
Intensive care unit	(23)	(15.3)
Burns unit	(4)	(2.7)
Community	57	38.0
<i>Primary cause of ARF</i>		
Acute tubular necrosis	93	62.5
Sepsis	(37)	(24.7)
Ischaemia	(19)	(12.7)
Rhabdomyolysis	(16)	(10.7)
Drugs (aminoglycosides)	(11)	(7.3)
Malaria	(5)	(3.3)
Snakebite	(2)	(1.3)
Other	(3)	(2.0)
Pre-renal failure	36	23.3
Glomerulonephritis	10	6.7
Obstructive uropathy	4	2.7
Interstitial nephritis	5	3.4
Vascular lesions	2	1.4
Total	150	100.0

n = total number of cases.

Epidemiology of acute renal failure in hospitalized patients: experience from southern Saudi Arabia

M. Al-Homrany¹

Table 4 Distribution of cases: comparison of hospital- and community-acquired acute renal failure (ARF)

Factor	Hospital-acquired ARF (n = 93)	Community-acquired ARF (n = 57)	P-value
Primary cause	Acute tubular necrosis	Glomerulonephritis	
Mortality (%)	51.6	21.1	<0.05
Need for dialysis (%)	19.4	24.6	NS
Full recovery (%)	37.6	64.9	<0.05
Mean age \pm s (years)	61.25 \pm 22.18	55.1 \pm 22.78	NS
Male (%)	55.9	63.2	NS
Female (%)	44.1	36.8	NS

s = standard deviation.

n = total number of cases.

NS = not significant.

Table 5 Multivariate logistic regression model: adjusted odds ratio (OR) and 95% confidence intervals (CI) of potential determinants of survival in cases of acute renal failure

Factor	Adjusted OR	95% CI	P-value
Age < 60 years	3.2	1.3–8.2	0.014
Peak BUN (< 160 mg/dL)	3.1	1.2–8.2	0.018
Hospital-acquired renal failure	5.0	1.9–12.5	0.001
No liver disease	5.1	1.2–21.3	0.025
Duration of renal failure (< 1 week)	3.9	1.5–11.1	0.004
No dialysis	10.7	3.0–37.5	0.000

BUN = blood urea nitrogen.

Table 3 Outcome of acute renal failure

Outcome	No. of cases	% (n = 150)
Full recovery	72	48.0
Partial recovery	17	11.3
Dialysis-dependent	1	0.7
Death	60	40.0
Sepsis and multi-organ failure	(39)	(26.0)
Myocardial infarction	(6)	(4.0)
Hepatic failure	(6)	(4.0)
Gastrointestinal bleeding	(4)	(2.7)
Cerebral haemorrhage	(3)	(2.0)
Arrhythmia	(2)	(1.3)
Total	150	100.0

n = total number of cases.

Acute Renal Failure in Jordan

Riyad Said

- A total of 215 patients, September 1996-through March 1998.
- CA: 70 patients.
- HA: 145 patients.
- **Sixty patients (28%) had pre-renal.**
- **30 patients (14%) had post-renal.**
- **Interinsic ARF 125 patients (58%).**
- Acute tubular necrosis (ATN) was the cause in 70 Cases (56%),
- glomerulonephritis/ vasculitis in 20 cases (16%),
- Acute interstitial nephritis "AIN" in 18 cases (14.4%) tumor lysis syndrome in eight cases (6.4%) .
- pregnancy related ARF in five cases (4%), and renal failure associated with hypercalcemia in four cases (3.2%).
- **Recovery:**
- Complete recovery of renal function was observed in 85 patients (68%).
- Partial recovery in ten patients (8%).
- No functional recovery 30 patients (24%) .
- Dialysis: Thirty patients (24%) required of whom 24 were oligo-anuric.
- Mortality:
- Thirty-five patients (28%) died.
- Both sepsis and cardiac causes were responsible for nearly 75% of the deaths.

Table 1. Acute tabular necrosis.		
	Number	%
1. Ischemic/Sepsis	30	42.9
2. Contrast nephropathy	15	21.4
3. Aminoglycoside toxicity+	10	14.3
4. Myoglobinuria	6	8.6
5. Hemoglobinuria	4	5.7
6. Multifactorial	5	7.1
Total	70	100

Original Article

Spectrum of Acute Kidney Injury in a Tertiary Care Hospital in Cairo

Amin R Soliman (MD)*

Cairo University, Cairo, Egypt

- The study aims to describe the spectrum of AKI in a tertiary hospital in Cairo. from January 2006 to January 2007 .
- **Acute kidney injury were acute deterioration in renal function with serum creatinine more than 2 mg/dl and the presence of normal sized kidneys or hydronephrotic kidneys with normal cortical thickness on ultrasonography.**
- **Fifty-one** patients (29 male and 22 female) were admitted with AKI during the study period.
- Dialysis therapy was required by 21(41%) cases; 19 patients received hemodialysis and two patients received peritoneal dialysis.
- Recovery :
- Normal renal function : Thirty-three patients (64.7%) recovered.
- Chronic kidney disease : Five patients (9.8%)
- two patients (4%) were lost follow up .
- overall mortality : Eleven patients died (21.6%).
- AE:
- the commonest causes of acute kidney injury in our setting were cardiovascular (19.6%),
- toxic insults (15.6%),
- glomerulonephritis (15.6%)
- and sepsis (11.7%).
- Most cases were managed conservatively with two thirds recovered full kidney function.

Original Article

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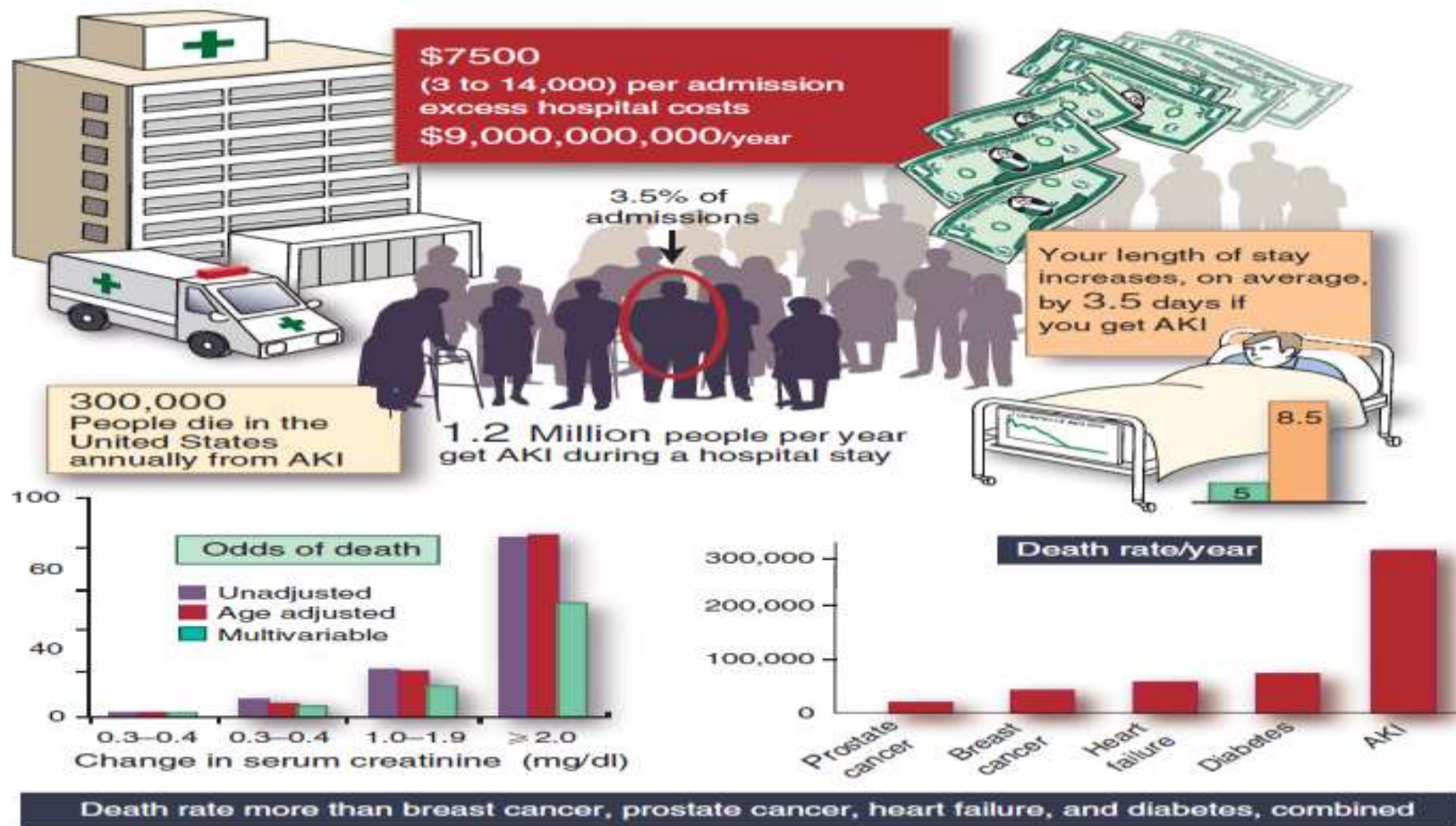
Cause	Number	Complete recovery	Progression to CKD	Death	Loss to follow up
Pre-renal azotemia/acute tubular necrosis					
Acute cardiac failure	10	7	1	2	-
Septicemia (e.g. pneumonia)	6	4	-	2	-
Obstetric (septic abortion)	5	2	1	2	-
Abdominal Surgery	4	2	-	2	-
Trauma/rhabdomyolysis	1	1	-	-	-
Gastroenteritis	1	1	-	-	-
Contrast induced nephropathy	8	5	1	1	1
Glomerulonephritis/vasculitis	8	6	1	1	-
Obstructive uropathy	5	3	-	1	1
Interstitial nephritis (infection/drug)	2	1	1	-	-
Urate nephropathy	1	1	-	-	-
Total	51	33	5	11	2

Presentation	%
Oliguria/ anuria	99
Uremic symptoms (inc. encephalopathy and seizures)	82
Features of fluid overload	56
Features of fluid depletion	18
Others (fever, jaundice)	33

Mortality and progression to CKD

Raising awareness of acute kidney injury: a global perspective of a silent killer

Andrew J.P. Lewington^{1,4}, Jorge Cerdá^{2,4} and Ravindra L. Mehta^{3,4}



The global burden of acute kidney injury (AKI)

Potentially relevant citations identified and screened for retrieval (Ovid and Embase database) (n=3808)

Duplicate citations between the two databases (n=689)

- **Systematic review and meta-analysis.**
- **Forty nine** studies that contained a

The incidence rate of CKD after an episode of AKI was 7.8 per 100 patient years and the rate of ESRD was 4.9 per 100 patient-years.

Studies excluded for various reasons (n=370)
Fewer than 50 patients (n=122)

long-term data for patients without AKI

The mortality rate of mortality was 8.9 per 100 person-years in survivors of AKI and was 4.3 per 100 patient-years in survivors without AKI (RR 2.59, 95% CI 1.97-3.42).

inclusion

Steven G. Coca. Et al , *Am J Kidney Dis*. 2009

Rate of CKD after AKI

From 2008 through 2010, four studies assessing four different cohorts of patients demonstrated that patients who survive an episode of AKI have a significant risk for the development of advanced CKD (stage 4/5).

Amdur RL, S et al.. Kidney Int 2009 .

Wald R, et al . JAMA 2009 .

Lo LJ et al Kidney Int 2009 .

Ishani A, et al. J Am Soc Nephrol 2009 •

- **5351** patients in the AKI population :
- **728 (13.6%)** entered CKD4 after hospitalization.
- **Risk factors**
- **Age** was associated with progression to CKD4 (each year of age raised the odds of entering CKD by 1%).
- **Presence of diabetes.**
- **Having ATN** was associated with progression to CKD4, raising the odds by 60% .
- **Need for dialysis** are at much higher risk for progression to CKD than patients with less severe AKI.

Table 1 | Univariate relationships with CKD4

Variable	No CKD4 (n=4623)	CKD4 (n=728)	Total (N=5351)	Univariate odds ratio (95% CI)
	n (column %)		n (column %)	
Race				
African American	1444 (31.2)	212 (29.1)	1656 (31.0)	
Hispanic	275 (6.0)	57 (7.8)	332 (6.2)	
Caucasian	2830 (61.2)	446 (61.3)	3276 (61.2)	
Other	74 (1.6)	13 (1.8)	87 (1.6)	
Gender				
Male	4519 (97.9)	713 (98.6)	5232 (98.0)	1.50 (0.78-2.89) NS
Female	95 (2.1)	10 (1.4)	105 (2.0)	
DM pre-admission				
Yes	1767 (38.2)	257 (35.3)	2024 (37.8)	1.13 (0.96-1.33) NS
No	2856 (61.8)	471 (64.7)	3327 (62.2)	
Dialysis***				
Never	4578 (99.0)	690 (94.8)	5268 (98.5)	
During hospitalization	39 (0.8)	18 (2.5)	57 (1.1)	
Post hospitalization	6 (0.1)	20 (2.8)	26 (0.5)	
Hospital complexity ^a				
1A	2493 (54.0)	392 (53.9)	2885 (53.9)	
1B	831 (18.0)	126 (17.3)	957 (17.9)	
1C	662 (14.3)	98 (13.5)	760 (14.2)	
2	469 (10.2)	81 (11.1)	550 (10.3)	
3	166 (3.6)	31 (4.3)	197 (3.7)	
Teaching hospital				
Yes	4080 (88.3)	630 (86.5)	4710 (88.1)	0.85 (0.68-1.07) NS
No	541 (11.7)	98 (13.5)	639 (12.0)	
ATN diagnosis**				
Yes	276 (6.0)	67 (9.2)	343 (6.4)	1.60 (1.21-2.11)
No	4347 (94.0)	661 (90.8)	5008 (93.6)	
	Mean \pm s.d.			
Age**	66.1 \pm 12.2	67.8 \pm 12.6	66.2 \pm 12.2	1.01 (1.005-1.02)
Alb-Base***	3.7 \pm 0.6	3.3 \pm 0.7	3.61 \pm 0.6	0.38 (0.33-0.43)
Alb-Hosp***	3.3 \pm 0.7	2.7 \pm 0.7	3.24 \pm 0.6	0.31 (0.27-0.36)
Hgb-Base***	12.9 \pm 1.9	12.4 \pm 1.8	12.9 \pm 1.9	0.86 (0.82-0.89)
Hgb-Hosp***	11.7 \pm 1.9	10.8 \pm 1.8	11.6 \pm 1.9	0.74 (0.71-0.78)
Residency slots	35.3 \pm 18.5	35.8 \pm 19.6	35.3 \pm 18.7	1.00 (1.00-1.01)
Baseline eGFR	80.4 \pm 17.3	81.6 \pm 18.1	80.6 \pm 17.4	1.00 (1.00-1.01)
Time at risk (years)***	2.35 \pm 1.62	2.79 \pm 1.67	2.41 \pm 1.6	1.18 (1.12-1.23)

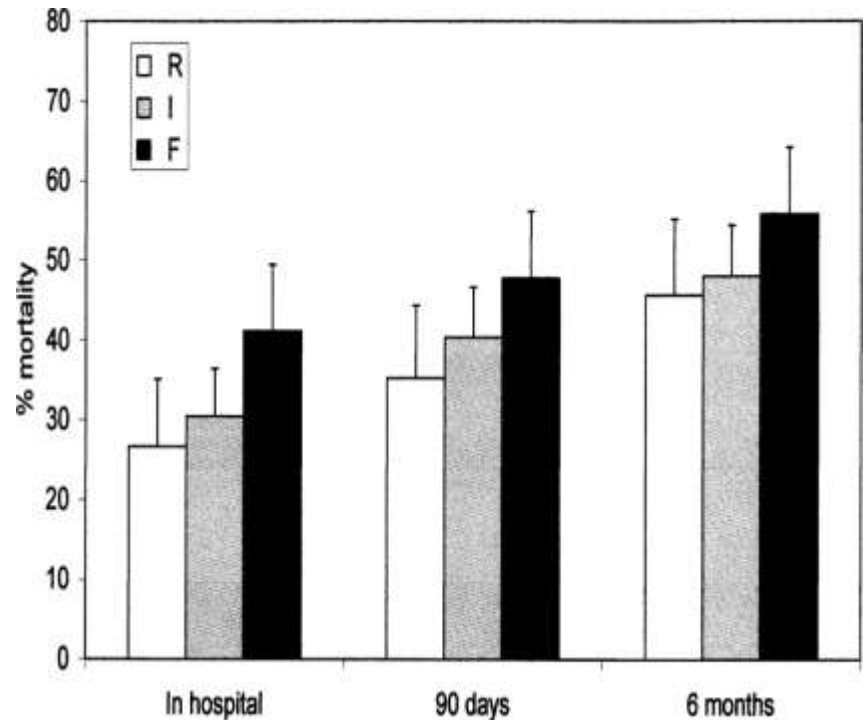
Abbreviations: Alb-Base, baseline serum albumin; Alb-Hosp, serum albumin during hospitalization; ATN, acute tubular necrosis; CI, confidence interval; CKD, chronic kidney disease; DM, diabetes mellitus; eGFR, estimated glomerular filtration rate; Hgb-Base, baseline serum hemoglobin; Hgb-Hosp, serum hemoglobin during hospitalization; ICU, intensive care unit; NS, not significant.

*P < 0.01 **P < 0.001 ***P < 0.0001.

^aVA hospital complexity is an administrative rating where 1 indicates treatment of high-risk patients, presence of specialty providers, high volume, complex ICU services, and research.

Mortality according to RIFLE

- Mortality increases proportionately with increasing severity of AKI (using RIFLE).
- AKI requiring RRT is an independent risk factor for in-hospital mortality.
- Mortality in pts with AKI requiring RRT 50-70%.
- Even small changes in serum creatinine are associated with increased mortality.



Hoste E, et al., . *Critical Care* 2006.
Chertow Gry. *American Journal of Medicine* 1998 .
Uchino S,, Bellomo R, et al. *JAMA* 2005.
Coca S, et al.: *American Journal of Kidney Diseases* 2007.

Raising the awareness

Targets



The 5R strategy for educating caregivers on AKI adapted from NHS

Category	Component	Areas of focus
<i>Risk assessment</i>	Susceptibility	Genetic, clinical risk scores
	Surveillance	E-alerts, drug dosing modifications
	Primary prevention	High-risk patients and situations, for example, contrast exposure
<i>Recognition</i>	Diagnosis	Functional changes (urine output), biomarkers
	Staging	AKIN, KDIGO, duration of AKI
<i>Response</i>	Reversible factors	Hydration, hemodynamics, relieve obstruction, remove nephrotoxic medications
	Avoid nephrotoxins	Drug dose adjustments
	Referral	Nephrology consultation in high-risk patients and at recognition
	Therapy	Emerging molecules targeting different pathways
<i>Renal support</i>	Dialytic modalities	Dosing, duration, and timing of initiation and withdrawal
<i>Rehabilitation</i>	Follow-up	Team approach (primary care, specialist, nursing, social worker, patient family)
	Recovery	Targeted interventions, for example, hypertension management
	Functional assessment	Quality of life

Abbreviations: AKI, acute kidney injury; AKIN, Acute Kidney Injury Network; KDIGO, Kidney Disease: Improving Global Outcomes; NHS, National Health Service.

HOW DO WE RAISE THE AWARENESS OF AKI?

- An **AKI toolkit** : A checklist of simple measures that can be instituted to reduce the risk of AKI and how to manage if it occurs.
- For certain groups of health-care professionals, it will be essential to provide clear **referral criteria**.
- **Patient education** needs to be improved with the provision of information on websites.
- Patients who have suffered an episode of AKI should be provided with information regarding the causes of the episode and the need for long-term follow-up.

CONCLUSION

- AKI is a worsening problem, but its actual **true incidence is unknown**.
- Knowledge of incidence and risk factors is crucial because it drives local and international efforts on detection and treatment.
- AKI also being more common in male elderly patients with preexisting CKD, diabetes, heart disease, hypertension, and cancer.
- Even mild AKI **is no longer considered to be benign**, but rather an independent predictor of mortality and is an important contributor to CKD .

CONCLUSION

- Nephrologists need to help implement strategies that lead to appropriate referral in order to **prevent CKD progression.**
- **Preventive and management strategies** for this condition need to be identified, implemented, and evaluated to limit the risks to susceptible individuals.
- It is necessary to **raise awareness of AKI** and to equip caregivers and patients with knowledge and tools to identify and adequately manage patients at risk.

Thank you

www.Oby25.org/about/acute-kidney-injury/

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Acute Kidney Injury

Acute kidney injury (AKI), previously referred to as acute renal failure (ARF), is characterised by an **abrupt loss of kidney function**. If left untreated, the condition has a high risk of multiple organ failure and, potentially, death. The increasing prevalence of AKI in developing and developed countries is strongly associated with increased early and long term patient morbidity and mortality, as well as the subsequent development of chronic kidney disease (CKD).

AKI has become a major global healthcare challenge with an estimated **13.3 million cases every year**. The burden is

https://www.google.com.eg/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CBwQFjAA&url=http%3A%2F%2Fwww.Oby25.org%2Fabout%2Facute-kidney-injury%2F&ei=owTTVjHGBsrUpCjsgH&usq=AFQjCNHiAG58-6XpmOd3ot1tszWxUD...

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- AKI has become a major global healthcare challenge with an estimated **13.3 million cases every year**. The burden is particularly high in developing countries, where the annual incidence is estimated to be **11.3 million cases**. Of the estimated **1.7 million deaths per year** caused by AKI globally, an estimated **1.4 million of those deaths occur in low- and middle-income countries**.

Gross domestic product (GDP)

- is defined by the [Organisation for Economic Co-operation and Development](#) (OECD) as "an aggregate measure of production equal to the sum of the gross values added of all resident, institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs)." [\[2\]](#)
- GDP estimates are commonly used to measure the economic performance of a whole country or region, but can also measure the relative contribution of an industry sector.

